

TOTAL MAXIMUM DAILY LOAD (TMDL)

For Sediment

In the Tobesofkee Creek Watershed

For Segments

Tobesofkee Creek (habitat due to sediment)

Tobesofkee Creek (biota due to sediment)



TOTAL MAXIMUM DAILY LOAD (TMDL)

Sediment

In the Tobesofkee Creek Watershed

Under the authority of Section 303(d) of the Clean Water Act, 33 U.S.C. 1251 et seq., as amended by the Water Quality Act of 1987, P.L. 100-4, the U.S. Environmental Protection Agency is hereby proposing a TMDL for sediment for the protection of aquatic life in the following segments of the Tobesofkee Creek Watershed in Georgia:

Tobesofkee Creek (habitat due to sediment)

Tobesofkee Creek (biota due to sediment)

The calculated allowable load of sediment that may come into the identified segments of the Tobesofkee Creek Watershed without exceeding the water quality target is an annual loading of 3.0 tons/acre/year. EPA interpreted the State of Georgia's narrative water quality standard for fish and wildlife for the protection of aquatic life to determine the applicable water quality target. Based on a current estimated annual loading of 2.0 tons/acre/year for the listed segment, no reduction in sediment loading is needed for the identified segment of the Tobesofkee Creek Watershed to meet the applicable water quality target. The sediment problem is due to historic landuse practices and migration of sediment from the headwater areas via tributaries to the main stream segments that caused high instream bedload sediment volume. (Trimble 1969)

Although watershed sediment load reductions are not needed, that appropriate it is recommended that Best Management Practices and continued compliance with the State of Georgia's stormwater construction permit be maintained and enforced to allow the stream to purge itself of the historic sediment loads.

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1. Executive Summary

The U.S. Environmental Protection Agency (EPA) Region 4 is proposing this Total Maximum Daily Load (TMDL) for sediment in the Tobesofkee Creek Watershed. The 303(d) listed segments in Georgia are:

Tobesofkee Creek (habitat due to sediment)

Tobesofkee Creek (biota due to sediment)

This TMDL satisfies a consent decree obligation established in *Sierra Club, et. al. v. EPA*, Civil Action, 1: 94-CV-2501-MHS (N.D. Ga.). The State of Georgia requested EPA to develop this TMDL for the impaired segments of the Tobesofkee Creek Watershed, and as such, EPA is proposing this TMDL for Georgia for the listed segment of the Tobesofkee Creek Watershed. This TMDL is being proposed in phases with this TMDL document representing the first phase of the process. If necessary, EPA expects to develop a revised TMDL for sediment for the Tobesofkee Creek Watershed in 2006. EPA believes that a phased approach is appropriate for this TMDL because information on the actual contributions of sediment to the Tobesofkee Creek Watershed from both point and nonpoint sources will be much better characterized in the future. In addition, information related to whether source reductions are being achieved could be reviewed to determine if any allocations of the load should be revisited.

In order for this TMDL to be developed, the applicable water quality target must be determined. The State of Georgia does not have a numeric water quality standard for the protection of aquatic life from excessive sedimentation. Based on site-specific field data from the Tobesofkee Creek Watershed, EPA has derived a numeric interpretation of the State of Georgia's narrative water quality standard for sediment to protect aquatic life due to excessive sedimentation. This interpretation of Georgia's water quality standard was based on site-specific data gathered for the Tobesofkee Creek Watershed in 1998 to 2001 specifically for the purpose of this TMDL. These field analyses were also used to determine that the listed impairments of "biota" or "habitat" were

due to sediment. In addition, in any future TMDLs for the Tobesofkee Creek Watershed, it is possible that EPA may revise this interpretation of the State's water quality standard based on new site-specific data collected at that time.

The calculated allowable load of sediment that may come into the identified segments of the Tobesofkee Creek Watershed without exceeding the water quality target is an annual loading of 3.0 tons/acre/year. EPA interpreted the State of Georgia's narrative water quality standard for fish and wildlife for the protection of aquatic life to determine the applicable water quality target. Based on a current estimated annual loading for the listed segment of 2.0 tons/acre/year, no reduction in sediment loading is needed for the identified segments of the Tobesofkee Creek Watershed to meet the applicable water quality target. The sediment problem is due to historic landuse practices and migration of sediment from the headwater areas via tributaries to the main stream segments that caused high instream bedload sediment volume. (Trimble 1969)

"Erosion and sedimentation are naturally occurring cyclical processes that have taken place on a continuous basis in many regions of the U.S. ... In the Georgia Piedmont, steep slopes, erodible soils, and intense rainfall combined with the land clearing and agricultural practices of the late nineteenth and early twentieth centuries led to accelerated erosion and sedimentation. Streams that once ran clear over small rocky channels (Bartram, 1928) ... now run turbid through large entrenched channels over mostly sediment covered bottoms ... Sediment delivery rates to streams have decreased significantly since the late nineteenth and early twentieth centuries ... Previously cultivated areas have been largely reforested and soil conservation practices have greatly improved ... Consequently, channel erosion and expansion through (historical) unstable deposits of modern sediments is quite common in many areas of the Piedmont. Headwater channels that had previously undergone intense sedimentation were being to degrade by 1969 while the distribution in the streams have changed during the last century" (Ruhlman and Nutter 1999). Sediment that had aggraded, due to past practices, in the headwater streams is now moving down the stream system in to the lower order streams, until this sediment is moved completely out of the stream system a habitat and biological impact will be seen.

2. Phased Approach to the TMDL

EPA recognizes that it may be appropriate to revise this TMDL based on information gathered and analyses performed after the TMDL is established. With such possible revisions in mind, this TMDL is characterized as a phased TMDL. In a phased TMDL, EPA or the state uses the best information available at the time to establish the TMDL at levels necessary to implement applicable water quality standards and to make the allocations to the pollution sources. However, the phased TMDL approach recognizes that additional data and information may be necessary to validate the assumptions of the TMDL and to provide greater certainty that the TMDL will achieve the applicable water quality standard. Thus, the Phase 1 TMDL identifies data and information to be collected after the first phase TMDL is established that would then be assessed and would form the basis for a Phase 2 TMDL. The Phase 2 TMDL may revise the needed load reductions or the allocation of the allowable load or both. EPA intends to gather new information and perform new analyses so as to produce a revised or Phase 2 TMDL for sediment for the identified segments of the Tobesofkee Creek Watershed, if necessary, in 2006. The phased approach is appropriate for this TMDL because information on the actual contributions of sediment to the Tobesofkee Creek Watershed from both point and nonpoint sources will be much better characterized in the future and additional reductions determined, if needed.

3. Problem Definition

The segment in the Tobesofkee Creek Watershed for which this TMDL is being proposed is included on the State of Georgia's 2000 Section 303(d) list. The purpose of this TMDL is to establish the acceptable loading of sediment from all watershed-based sources, such that sediment levels in the Tobesofkee Creek Watershed will not exceed the applicable water quality standard as interpreted by EPA for protection aquatic life.

4. Applicable Water Quality Standard

TMDLs are established at levels necessary to attain and maintain the applicable narrative and

numerical water quality standards. (See 40 CFR Section 130.7(c)(1).) The State of Georgia's Rules and Regulations for Water Quality Control do not include a numerical water quality standard for aquatic life protection due to sediment. The narrative standard is to maintain the biological integrity of the waters of the State – Georgia's Water Quality Standard is established in Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6, Revised July, 2000 Georgia Regulation 391-3-6-.03(2)(a).

The calculated allowable load of sediment that may come into the identified segment of the Tobesofkee Creek Watershed without exceeding the water quality target is an annual loading of 3 tons/acre/year. This loading value is based on the average sediment load in unimpaired watersheds that ranged from 0.2 to over 7 tons/acre/year. (GaDNR 2001) **EPA interpreted the State of Georgia's narrative water quality standard for fish and wildlife for the protection of aquatic life to determine the applicable water quality target. Based on a current estimated annual loading of 2.0 tons/acre/year for the listed segment, no reduction in sediment loading is needed for the identified segments of the Tobesofkee Creek Watershed to meet the applicable water quality target.**

5. Background

The Tobesofkee Creek Watershed is located in northeastern Georgia. The location of the watershed is shown in Figure 1.

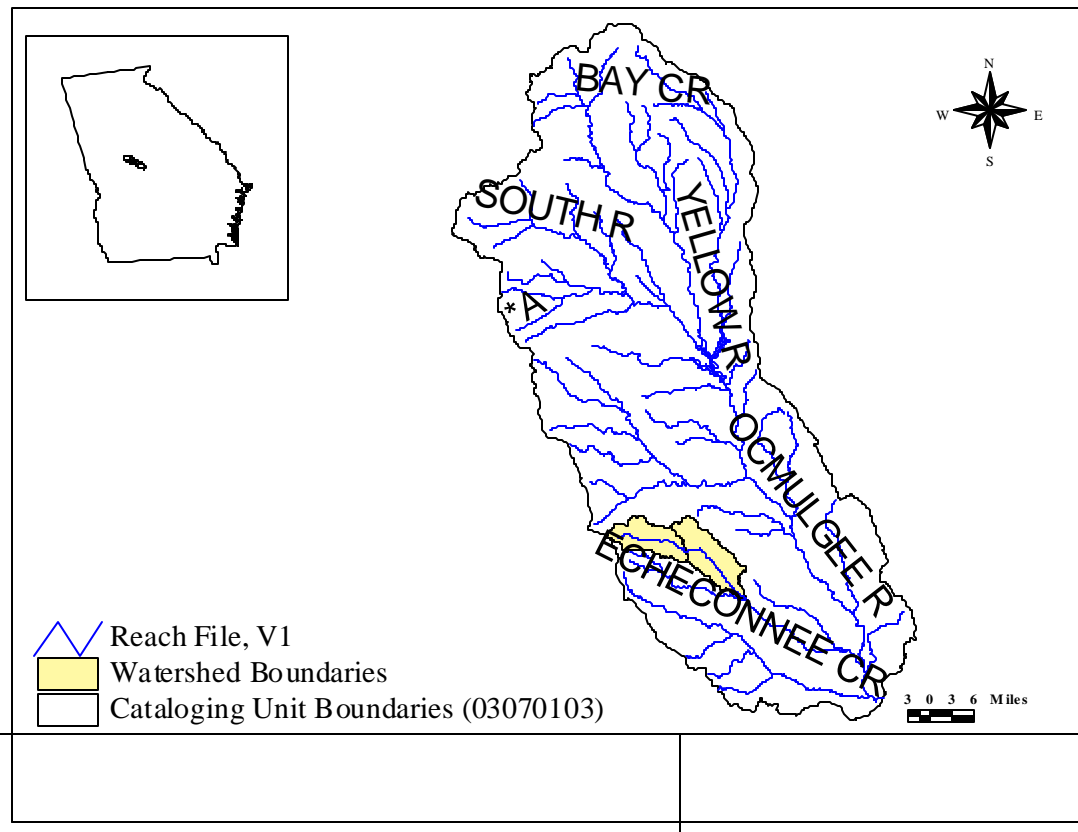


Figure 1: Tobesofkee Watershed Location Map

EPA developed TMDLs for the listed segment in the watershed. The watershed contains several different types of land uses. Different land uses collect and distribute sediment at different rates as a function of runoff and erosion. Figure 2 illustrates the land uses in the Tobesofkee Creek Watershed.

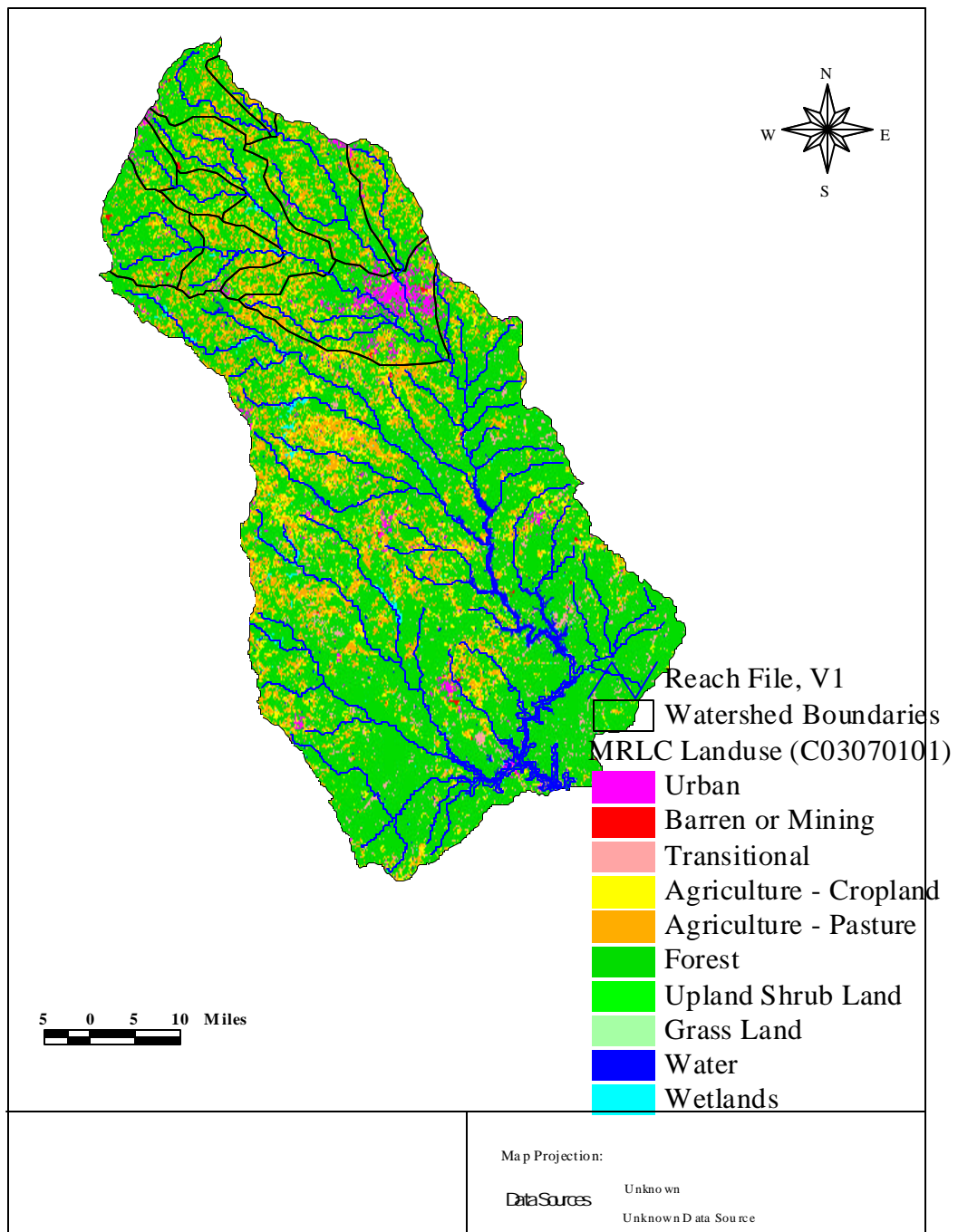


Figure 2: Tobesofkee Creek Basin Landuse

5.1. Source Assessment

A TMDL evaluation examines the known potential sources of the pollutant in the watershed, including point sources, nonpoint sources, and background levels. For the purpose of this TMDL, facilities permitted under the National Pollutant Discharge Elimination System (NPDES) Program are considered point sources.

5.1.1. Point Sources:

Two continuous NPDES permitted discharge from municipal wastewater treatment facilities are located in the Georgia portion of the 303(d) listed streams. They contribute less than 0.1% of the annual sediment load.

Table 1: Point Source Loads

| Facility | Permit # | Receiving waters | Flow (mgd) | TSS (mg/l) | TSS (tons/yr) |
|------------------------|-----------------|-------------------------|-----------------------|-----------------------|--------------------------|
| William Carter Company | GA0003115 | Tobesofkee Creek | | | 119 |
| Barnesville WTF | GA0021041 | Tobesofkee Creek | 0.95 | 30 | 43 |

Other potential point sources discharges in the Georgia portion of the listed streams are storm water discharges associated with construction activity. The State of Georgia Department of Natural Resources, Environmental Protection Division has developed a general storm water permit. All existing and new storm water point sources within the State of Georgia, that are required to have a permit, are authorized to discharge storm water associated with construction activity to the waters of the State of Georgia in accordance with the limitations, monitoring requirements and other conditions set forth in Parts I through VII of the Georgia Storm Water General Permit. The permit limitations are established to assure that the storm water runoff from these point source sites do not cause or contribute to the existing sediment impairment. A Comprehensive Monitoring Plan with turbidity monitoring requirements is required to assure any storm water discharge from the site does

not cause or contribute to the existing sediment problem.

The Georgia General Storm Water Permit for Construction Activities (Storm Water Permit) was developed to reduce the input of sediment from construction activities. As an example, in the Middle Oconee Watershed, based on the available mid 1990s landuse information, it was estimated that, absent the limitations established by the Storm Water Permit, construction would contribute 450 tons/square-mile/year to the stream sediment load. Implementation of the Storm Water Permit in the Middle Oconee Watershed, which has the highest contribution from construction activities, should reduce the sediment contributed by these construction activities to 0.1 tons/acre/year. This level is below the target of 3 tons/acre/year. This reduced load would be less than 1% of the total allowable sediment load for the watershed.

The Georgia General Storm Water Permit can be considered to be a water quality-based permit, in that the numeric limits in the permit, if met and enforced, will not cause a water quality problem in a unimpaired stream or contribute to an existing problem in an impaired stream. It is recommended that for impaired watersheds, the cold water (trout stream) turbidity table be used.

5.1.2. Existing Nonpoint Watershed Sediment Loads:

The long-term sediment watershed load was calculated using the Universal Soil Loss Equation (USLE) (see Appendix A) and broken down by land use sediment sources and road erosion sediment sources.

5.1.3. Tobesofkee Creek Basin – HUC 03070103

The current estimated long-term area weighted watershed sediment load for Tobesofkee Creek Watershed is shown in Table 2.

Table 2: Watershed Sediment Loads

| Listed Streams – Georgia | Watershed | Watershed (Tons/Year) | Area (Sq.Mi.) | Area Weighted (Tons/Acre/Year) |
|---------------------------------|------------------------|------------------------------|----------------------|---------------------------------------|
| Tobesofkee Creek | Tobesofkee Creek Basin | 109,000 | 85 | 2.0 |

6. EPA Region 4 Biological/Habitat Data and Information

Biological and habitat data were collected in 2001. (EPA 2001) A habitat rating of 130 to 175 indicates a good or health habitat, 90 to 129 indicates a fair but impacted habitat and less than 90 indicates a poor habitat. Table 3 shows the habitat ratings for the listed segment of the Tobesofkee Creek watershed.

Table 3: Habitat Ranking

| Stream Name | Listing Reason | Station Locator | Pollutant Of Concern | Habitat Rating |
|--------------------|-----------------------|------------------------|-----------------------------|-----------------------|
| Tobesofkee Creek | Biota and Habitat | TC02 | Sediment | 116 |

7. Model Development

The link between the biota and habitat alteration due to sediment loads and the identified sources of sediment is the basis for the development of the TMDL. The linkage is defined as the cause and effect relationship between the selected indicators and identified sources. This provides the basis for estimating the total assimilative capacity of the river and any needed load reductions. Details of the sediment-loading model are in Appendix A.

7.1. *Instream Sediment Impacts*

The instream flows and sediment concentrations were estimated based on daily flows proportioned from the Tobesofkee Creek USGS gage #02220900. The USLE predicted annual loadings and the following sediment flow relationship:

$$\text{TSS (mg/l)} = \text{coefficient} * (\text{Flow} / \text{Mean Flow}) ^{0.85}$$

This relationship was developed for the Oconee Watershed based on sediment and flow data collected historically by USGS. Figure 3 illustrates the estimated flow and sediment concentrations for Middle Tobesofkee Creek watershed.

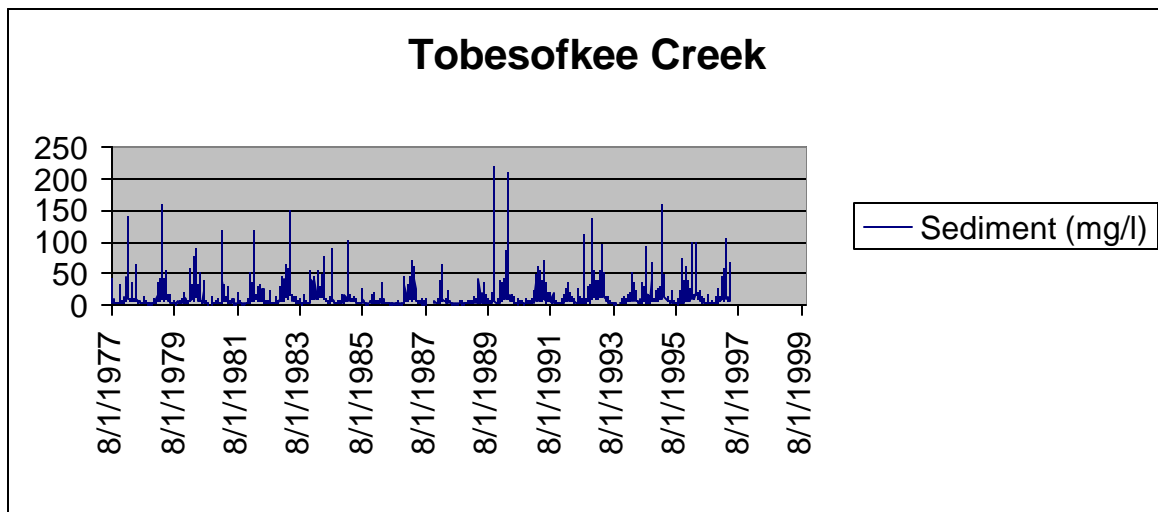


Figure 3: Tobesofkee Creek Watershed Estimated Sediment Concentrations

8. Numeric Sediment Target Determination

8.1. *Numeric Target*

The working hypothesis for the sediment watershed load is that if the Tobesofkee Creek Watershed has a long-term annual sediment load similar to a relatively biologically unimpacted healthy stream, then the Tobesofkee Creek Watershed will remain stable and not be biologically impaired due to sediment. Biologically unimpacted streams in the Tobesofkee Creek Basin were used to develop a target sediment watershed load. A biologically unimpacted stream's watershed sediment loading rate per area average of around 3.0 tons/acre/year was developed as an acceptable loading rate. (GDNR 2001)

9. Total Maximum Daily Load (TMDL) Factors

The TMDL is the total amount of a pollutant that can be assimilated by the receiving waterbody without exceeding the applicable water quality standard, in this case, a numeric interpretation of the State of Georgia's narrative water quality standard for aquatic life. This TMDL determines the maximum load of sediment that can enter the Tobesofkee Creek Watershed. Based on a current estimated annual loading, from the listed segments that range from 0.2 to 0.7 tons/acre/year, no reduction in sediment loading is needed for the identified segments of the Tobesofkee Creek Watershed to meet the applicable water quality target. The sediment problem is due to historic landuse practices and migration of sediment from the headwater areas via tributaries to the main stream segments that caused high instream bedload sediment volume.

9.1. *Critical Condition Determination*

The annual average watershed load represents the long-term processes of accumulation of sediments in the stream habitat areas that are associated with the potential for habitat alteration and aquatic life effects.

9.2. Seasonal Variation

The average annual load addresses seasonal variation.

9.3. Margin of Safety

A Margin of Safety (MOS) is a required component of a TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody. The MOS is typically incorporated into the conservative assumptions used to develop the TMDL. A MOS is incorporated into this TMDL in a variety of ways. These include a MOS implicitly assigned by selection of average USLE factors and by the average sediment loading numeric target.

9.4. TMDL Development

The maximum daily loads for each listed segment in the Oconee Watershed were estimated using daily flows proportioned from the Tobesofkee Creek USGS gage 02220900, the USLE predicted annual loadings and the following sediment flow relationship where:

$$\text{TSS (mg/l)} = \text{coefficient} * (\text{Flow} / \text{Mean Flow}) ^ 0.85$$

9.5. TMDL Determination

The Tobesofkee Creek Watershed existing loads are presented in Table 4.

Table 4: Existing Watershed Loads

| Watershed Stream Name | Existing Sediment Daily Loads (Daily Maximum) | Existing Annual Sediment Loads (tons/acre/year) |
|----------------------------------|--|--|
| Tobesofkee Creek | 8,900 tons/day | 2.0 |

10. Allocation of Loads

In a TMDL assessment, the total allowable load is divided and allocated to the various pollutant sources – both point sources and nonpoint sources. Allocations provided to point sources are wasteload allocations (WLAs). Based on the numeric limits of the storm water permit the area loading will be 0.09 tons/acre/year, which is below the target of 3 tons/acre/year.

Allocations to nonpoint sources are load allocations (LAs). Roads, agriculture and bare ground (construction sites, etc.) are the major sediment producing areas in the watershed. If best management practices (BMPs), as outlined in “Georgia’s Best Management Practices for Forestry” (GaEPD 1999), for these practices and other sediment producing activities are implemented at the sites that are near the stream’s drainage network and the stream’s riparian zone or buffer zones are maintained or restored, then the TMDL targets can be met. Detailed BMP measures are discussed in Georgia Environmental Protection Division’s Tobesofkee Creek Basin TMDL report (GaDNR 2001).

The calculated allowable load of sediment that can come into the Tobesofkee Creek Watershed without exceeding the applicable narrative water quality standard, as interpreted by EPA, is 3 tons/acre/year. For example, in the Tobesofkee Creek Watershed, this assessment indicates that over 99% of the loading of sediment is from nonpoint sources and construction activity prior to issuance of Georgia’s Storm Water Permit. Implementation of the Storm Water Permit will reduce construction sediment runoff. Additional sediment reduction activities should target nonpoint sources, including the unpaved roads, to gain the greatest water quality benefit.

10.1. TMDL Formula:

TMDL = WLA + LA + MOS, where:

- TMDL = 3 tons/acre/year or 163,000 tons/year for an 85 square mile watershed
- Wasteload Allocation (WLA) = WLA from wet weather discharges subject to the General Storm Water Permit = 0.09 tons/acre/year;
- WLA for William Carter Company NPDES Permit # GA0003115 = 119 ton/year; and
- WLA for Barnesville WTF NPDES Permit # GA0021041 = 43 ton/year
- Load Allocation (LA) from nonpoint source runoff and roads = 2.9 tons/acre/year

10.2. TMDL Assumptions:

The allocations in this TMDL reflect the following assumptions regarding ongoing watershed restoration and/or pollution control activities in the Tobesofkee Creek Watershed:

EPA assumes that construction activities in the watershed will be conducted in compliance with Georgia's Storm Water General Permit for construction activities, including discharge limitations and monitoring requirements contained in the General Storm Water Permit. Compliance with these permits will lead to sediment loadings from construction sites at or below applicable targets.

With respect to all land disturbance activities, including road building and maintenance, if these BMPs are implemented, then EPA believes that water quality targets for sediment will be achieved throughout the Tobesofkee Creek Watershed.

The wasteload allocation component of this TMDL reflects the following additional assumptions:

-
- No NPDES point source will be authorized to increase its mass loading of sediment above levels reflected in current water quality-based effluent limitations or allowed in the State's General Storm Water Permit.
 - The permitting authority will establish the shortest reasonable period of time for compliance with permit limitations and conditions based on this TMDL.

These assumptions provide reasonable assurance that the allocation of loads in this TMDL, described in more detail below, are appropriate. During Phase 1 of this TMDL, EPA and Georgia will gather data and information to determine whether continued reliance on these assumptions is reasonable. The Phase 2 TMDL may revise the allocation of the allowable load, as necessary, should EPA or Georgia be required to change the assumptions underlying that allocation.

10.3. Allocation to Nonpoint Sources

It is recommended that the Tobesofkee Creek watershed be considered a high priority for riparian buffer zone restoration and any sediment reduction BMPs, especially for the road crossings, agricultural activities, and construction activities. Further ongoing monitoring needs to be completed to monitor progress and to assure further degradation does not occur.

For those land disturbing activities related to silviculture that may occur on public lands, it is recommended that practices as outlined for landowners, foresters, timber buyers, loggers, site preparation and reforestation contractors, and others involved with silvicultural operations follow the practices to minimize nonpoint source pollution as outlined in "Georgia's Best Management Practices for Forestry (GaEPD 1999).

10.3.1. Storm Water Point Sources

Other potential point sources discharges in the Georgia portion of the listed streams are storm water discharges associated with construction activity. The State of Georgia Department of Natural Resources, Environmental Protection Division has developed a general storm water permit. All

existing and new storm water point sources within the State of Georgia, that are required to have a permit, are authorized to discharge storm water associated with construction activity to the waters of the State of Georgia in accordance with the limitations, monitoring requirements and other conditions set forth in Parts I through VII of the Georgia Storm Water General Permit. The permit limitations are established to assure that the storm water runoff from these point source sites does not cause or contribute to the existing sediment impairment. A Comprehensive Monitoring Plan with turbidity monitoring requirements is required to assure any storm water discharge from the site does not cause or contribute to the existing sediment problem.

The Georgia General Storm Water Permit for Construction Activities (Storm Water Permit) was developed to reduce the input of sediment from construction activities. As an example, in the Tobesofkee Creek Watershed, based on the available mid 1990s landuse information, it was estimated that, absent the limitations established by the Storm Water Permit, construction would contribute 450 tons/square-mile/year to the stream sediment load. Implementation of the Storm Water Permit in the Tobesofkee Creek Watershed, which has the highest contribution from construction activities, should reduce the sediment contributed by these construction activities to 55 tons/square-mile/year (0.45 lbs/day/acre), which is below the target of 500 tons/square-mile/year. This reduced load would be less than 1% of the total sediment allowable load for the Tobesofkee Creek Watershed.

The Georgia General Storm Water Permit can be considered to be a water quality-based permit, in that the numeric limits in the permit, if met and enforced, will not cause a water quality problem in a unimpaired stream or contribute to an existing problem in an impaired stream. A Comprehensive Monitoring Plan with turbidity monitoring requirements is required to assure any storm water discharge from the site does not cause or contribute to the existing sediment problem. Since the point source storm water component is addressed and controlled through the implementation and enforcement Georgia Storm Water Permits. It is recommended that for streams in the impaired watersheds the cold water (trout stream) turbidity table be used. Based on the numeric limits of the storm water permit the area loading will be 55 tons/square-mile/year or 0.15 lbs/day/sq.mi., which

is below the target of 90 tons/square-mile/year. This will ensure that permitted point source sediment loads in the watersheds will contribute less than 1% of the total sediment.

The Georgia General Storm Water Permit can be considered to be a water quality-based permit, in that the numeric limits in the permit, if met and enforced, will not cause a water quality problem in a unimpaired stream or contribute to an existing problem in an impaired stream.

This TMDL accords the permitting authority a certain amount of discretion in incorporating these wasteload allocations into NPDES permits. The permitting authority can determine the appropriate frequency, duration and location of monitoring associated with the sediment characterization component of the wasteload allocation. The permitting authority also has the discretion to determine the level of oversight in connection with the development of sediment minimization plans and the discharger's choice of appropriate, cost-effective measures to implement such plans. EPA believes that each of these decisions is heavily fact-dependent and that the permitting authority is the appropriate decision maker in this regard.

10.4. Implementation

EPA has always recognized that implementation of TMDLs is important, since a TMDL improves water quality when the pollutant allocations are implemented, not when a TMDL is established. EPA believes, however, that TMDL implementation – and implementation planning – is the responsibility of the State of Georgia, through its administration of the National Pollutant Discharge Elimination System (NPDES) point source permit program and through its administration of any regulatory or non-regulatory nonpoint source control programs. Neither the Clean Water Act nor EPA's current regulations require a TMDL to include an implementation plan.

A consent decree in the case of Sierra Club v. EPA, 1:94-cv-2501-MHS (N.D. Ga.) requires the State or EPA to develop TMDLs for all waterbodies on the State of Georgia's current 303(d) list according to a schedule contained in the decree. On July 24, 2001, the district court entered an order finding that the decree also requires EPA to develop TMDL implementation plans. EPA

disagrees with the court's conclusion that implementation plans are required by the decree and has appealed the July 24, 2001, order.

The Agency is moving forward, however, to comply with the obligations contained in the order. Since EPA does not believe it is possible to propose an adequate plan in the time available between July 24, 2001 and the proposal of this TMDL, this proposal outlines the steps EPA intends to undertake to develop an implementation plan before the TMDL is established.

Between now and the time this TMDL is established, EPA intends to coordinate with the Georgia Environmental Protection Division to prepare an implementation plan for this TMDL. EPA will work with the Georgia Environmental Protection Division to facilitate stakeholder involvement in this process, including members of the public and appropriate units of local, state, and federal government. EPA will make its best efforts to afford the public an opportunity to provide comments about an implementation plan before it is finalized. If the July 24, 2001 Order is vacated, EPA would expect to support efforts by the State of Georgia to develop an implementation plan for this TMDL.

11. State and Federal Responsibility

EPA intends to undertake the following responsibilities under this TMDL:

1. Review “major” NPDES permits and other identified “minor” NPDES permits for facilities located in the watershed of the segments of the Tobesofkee Creek Watershed that are covered by this TMDL;
2. Take the lead on revising the TMDL, if needed.

EPA expects Georgia to undertake the following responsibilities for the Tobesofkee Creek Watershed:

1. Identify the “major” NPDES facilities affected by this TMDL;
2. Implement the Georgia General Storm Water Permit.
3. Maintain the Notices of Intent that include the location and duration period of the General Storm Water Permits issued in the Tobesofkee Creek Watershed and review the monitoring data, submitted to Georgia pursuant to monitoring requirements of the General Storm Water Permit.

12. References

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13. Appendix A

13.1. Watershed Sediment Loading Model

An analysis of watershed loading could be conducted at various levels of complexity, ranging from a simplistic gross estimate to a dynamic model that captures the detailed runoff from the watershed to the receiving waterbody. The limited amount of data available for the Tobesofkee Creek Watershed prevented EPA from using a detailed dynamic watershed runoff model, which needs a great deal of data for calibration. Instead, EPA determined the sediment contributions to the Tobesofkee Creek Watershed from the surrounding watershed based on an annual mass balance of sediment in water and sediment loading from the watershed.

Watershed-scale loading of sediment in water and sediment was simulated using the Watershed Characterization System (WCS) (USEPA, 2001). The complexity of this loading function model falls between that of a detailed simulation model, which attempts a mechanistic, time-dependent representation of pollutant load generation and transport, and simple export coefficient models, which do not represent temporal variability. The WCS provides a mechanistic, simplified simulation of precipitation-driven runoff and sediment delivery, yet is intended to be applicable without calibration. Solids load from runoff can then be used to estimate pollutant delivery to the receiving waterbody from the watershed. This estimate is based on sediment concentrations in wet and dry deposition, which is processed by soils in the watershed and ultimately delivered to the receiving waterbody by runoff, erosion and direct deposition.

13.1.1. Universal Soil Loss Equation

The Universal Soil Loss Equation (USLE), developed by Agriculture Research Station (ARS) scientists W. Wischmeier and D. Smith, has been the most widely accepted and utilized soil loss equation for over 30 years. Designed as a method to predict average annual soil loss caused by sheet and rill erosion, the USLE is often criticized for its lack of applications. While it can estimate

long-term annual soil loss and guide conservationists on proper cropping, management, and conservation practices, it cannot be applied to a specific year or a specific storm. The USLE is mature technology and enhancements to it are limited by the simple equation structure. However based on its long history of use and wide acceptance by the forestry and agriculture communities, it was selected as an adequate tool for estimating long-term annual soil erosion, for evaluating the impacts of land use changes and evaluating the benefits of various Best Management Practices (BMPs).

The Sediment Tool, which incorporates the USLE equation, is an extension of the Watershed Characterization System (WCS). For more detailed information on WCS, refer to the WCS User's Manual. The Sediment Tool can be used to perform the following tasks:

- Estimate extent and distribution of potential soil erosion in the watershed.
- Estimate potential sediment delivery to receiving waterbodies.
- Evaluate effects of land use, BMPs, and road network on erosion and sediment delivery.

Soil loss from sheet and rill erosion is mainly due to detachment of soil particles during rainfall. It is the major soil loss from crop production and grazing areas, construction sites, mine sites, logging areas, and unpaved roads. The magnitude of soil erosion is normally estimated through the use of the Universal Soil Loss Equation (USLE). The USLE equation is a multiplicative function of crop and site specific factors that represent rainfall erosivity (R), soil erodibility (K), soil slope (S), slope length (L), cropping or conservation management practices (C), and erosion control practices (P). The R factor describes the kinetic energy generated by the frequency and intensity of rainfall. The K factor represents the susceptibility of soil to erosion (i.e. soil detachment). The L and S factors represent the effect of slope length and slope steepness on erosion, respectively. The C factor represents the effect of plants, soil cover, soil biomass and soil disturbing activities on erosion including crop rotations, tillage and residue practices. Finally, the P factor represents the effects of conservation practices such as contour farming, strip cropping and terraces.

The USLE equation for estimating average annual soil erosion is:

$$A = RKLSCP$$

- **A** = average annual soil loss in t/a (tons per acre)
- **R** = rainfall erosivity index
- **K** = soil erodibility factor
- **LS** = topographic factor - L is for slope length & S is for slope
- **C** = cropping factor
- **P** = conservation practice factor

Evaluating the factors in USLE:

R - the rainfall erosivity index

Most appropriately called the erosivity index, it is a statistic calculated from the annual summation of rainfall energy in every storm (correlates with raindrop size) times its maximum 30 - minute intensity. As expected, it varies geographically.

K - the soil erodibility factor

This factor quantifies the cohesive or bonding character of a soil type and its resistance to dislodging and transport due to raindrop impact and overland flow.

LS - the topographic factor

Steeper slopes produce higher overland flow velocities. Longer slopes accumulate runoff from larger areas and also result in higher flow velocities. Thus, both result in increased erosion potential, but in a non - linear manner. For convenience L and S are frequently lumped into a single term.

C - the crop management factor

This factor is the ratio of soil loss from land cropped under specified conditions to corresponding loss under tilled, continuous fallow conditions. The most computationally complicated of USLE factors, it incorporates effects of: tillage management (dates and types), crops, seasonal erosivity index distribution, cropping history (rotation), and crop yield level (organic matter production potential).

P - the conservation practice factor

Practices included in this term are contouring, strip cropping (alternate crops on a given slope established on the contour), and terracing.

Appropriate values for the USLE parameters should be provided for each of the management activities. Literature values are available, but site-specific values should be used when available. Estimates of the USLE parameters and thus the soil erosion as computed from the USLE equation are provided by the Natural Resources Conservation Service's National Resources Inventory (NRI) 1994. The NRI database contains information of the status, condition and trend of soil, water and related resources collected from approximately 800,000 sampling points across the country.

Soil loss from gully erosion occurs in sloping areas mainly as a result of natural processes. Farming

practices such as livestock grazing exacerbates it. The deepening of rill erosion causes gullies. The amount of sediment yield from gully erosion is generally less than that caused by sheet and rill erosion. There are no exact methods or equations to quantify gully erosion, but Dunne and Leopold (1978) provide percent sediment yield estimates for various regions of the country. In a small grazed catchment near Santa Fe, New Mexico, gully erosion was found to contribute only 1.4 percent of the total sediment load as compared to sheet erosion and rain splash, which contributed 97.8 percent of the sediment load. Dunne and Leopold report that in most cases (nationally and internationally) gully erosion contributes less than 30 percent of the total sediment load, although the percentages have ranged from 0 percent to 89 percent contribution (Dunne and Leopold, 1978).

The soil losses from the erosion processes described above are localized losses and not the total amount of sediment that reaches the stream. The fraction of the soil losses in the field that is eventually delivered to the stream depends on several factors, which include the distance of the source area from the stream, the size of the drainage area, and the intensity and frequency of rainfall. Soil losses along the riparian areas are expected to be delivered into the stream with runoff-producing rainfall.

13.1.2. Sediment Analysis

The watershed sediment loads for selected watersheds are determined using the USLE and available GIS coverage. The sediment analysis produces the following outputs:

- Source Erosion and Sediment
- Stream Grid
- Sediment Delivery on Stream

The sediment analysis is also able to evaluate default scenarios by, for example, changing land uses and BMPs. The following are some of the parameters that may be altered:

- C and P Lookup values

- Land Use Change Layer
- BMP Layers
- Add/Delete Roads
- Create Road Control Structure Layer

The sediment analysis can be run for a single watershed or multiple watersheds. For TMDL development purposes the basic sediment analysis was used for developing relative impacts. Other applications used in developing the TMDL include the evaluation of the effectiveness of BMPs and development of implementation plans.

13.1.3. Sediment Modeling Methodology

The watersheds of interest are first delineated. The stream grid for each delineated watershed, based on the Digital Elevation Maps (DEM) data, is created so that the stream matches the elevation (i.e., the stream corresponds to the lower elevations in the watershed). The system uses this threshold to determine whether a particular grid cell corresponds to a stream. Grid cells having flow accumulation values higher than the threshold will be considered as part of the stream network.

The RF3 stream network is used as a reference or basis of comparison to obtain the desired stream density. A stream grid corresponding to the stream network that has fifty 30 by 30 meter headwater cells is the default.

For each 30 by 30 meter grid cell the potential erosion based on USLE and potential sediment delivery to the stream network is estimated. The potential erosion from each cell is calculated using the USLE and the sediment delivery to the stream network can be calculated using one of four available sediment delivery equations.

(1) Distance-based equation 1 (Sun and McNulty 1988)

$$Md = M * (1 - 0.97 * D / L),$$

$$L = 5.1 + 1.79 * M,$$

Where M_d is the mass moved from each cell to the closest stream network (US tons/acre/yr);

D (feet) is the least cost distance from a cell to the nearest stream network; and

L (feet) is the maximum distance that sediment with mass M (US ton) may travel.

(2) Distance-based equation 2 (Yagow et al. 1998)

$$DR = \exp (-0.4233 * L * Sf),$$

$$Sf = \exp (-16.1 * (r / L + 0.057)) - 0.6,$$

Where DR is the sediment delivery ration;

L is the distance to stream in meters and

r is the relief to stream in meters.

(3) Area-based equation (converted from a curve from National Engineering Handbook by Soil

Conservation Service 1983

$$DR = 0.417762 * A ^ (-0.134958) - 0.127097,$$

$$DR \leq 1.0,$$

Where DR is the sediment delivery ratio and

A is area in square miles;

(4) WEPP-based regression equation (L.W.Swift, Jr.,2000)

$$Z = 0.9004 - 0.1341 * X - 0.0465 * X^2 + 0.00749 * X^3 -$$

$$0.0399*Y+0.0144*Y^2+0.00308*Y^3,$$

$$X>0,Y>0,$$

Where Z is percent of source sediment passing to next grid cell,

X is cumulative distance downslope,

Y is percent slope in grid cell.

The sediment analysis provides the calculations for six new parameters.

- Source Erosion – estimated erosion from each grid cell due to the land cover
- Road Erosion – estimated erosion from each grid cell representing a road
- Composite Erosion – composite of the source and road erosion layers
- Source Sediment – estimated fraction of the soil erosion from each grid cell that reaches the stream (sediment delivery)
- Road Sediment – estimated fraction of the road erosion from each grid cell that reaches the stream
- Composite Sediment – composite of the source and erosion sediment layers

The sediment delivery can be calculated based on the composite sediment, road sediment, or source sediment layer. The sources of sediment by each land use type is determined showing the types of land use, the acres of each type of land use, and the tons of sediment estimated to be generated from each land use. The information and estimates developed using this methodology were summarized in Tables 1 through 5 in Section 5.

13.1.4. Sediment Analysis Inputs

Before conducting a sediment analysis, a number of data layers must be available. These include

the following:

- DEM (grid) – The DEM layers that come with the WCS distribution system are shape files and are of coarse resolution (300 m x 300 m). The user needs to import a DEM grid layer. A higher resolution DEM grid layer (30m x 30 m) was downloaded from USGS web site or from a state's GIS data clearinghouse
- Road – The road layer is needed as a shape file and requires additional attributes such as C (road type), P (road practice) and ditch (value of either 3 or 4, indicating presence or absence of side ditch, respectively). If these attributes are not provided, the Sediment Tool automatically assigns default values of road type 2 (secondary paved roads) ditch 3 (with ditch) and road practice 1 (no practices).
- Soil – The SSURGO (1:24k) soil data may be imported into the WCS project if higher-resolution soil data is required for the estimation of potential erosion. If the SSURGO soil database not available, the system uses the STATSGO Soil data (1:250k) by default.
- The Multi-Resolution Land use Classification (MRLC) data are also used.
- Rainfall erosivity index is either provides based on a rainfall index of the USA or can be calculated based on precipitation data.

The Universal Soil Loss Equation (USLE) R, K, LS, C, and P factors are calculated from the above data as follows:

$$A = RKLSCP$$

- **A** = average annual soil loss in t/a (tons per acre) is calculated.
- **R** = rainfall erosivity index is provide based on a rainfall index of the USA.
- **K** = soil erodibility factor calculated based on soil types.

- **LS** = topographic factor - L is for slope length set at 30 meters and S is for slope calculated based on the 30 meter DEM data. Presently a watershed average LS term is used.
- **C** = cropping factor or land use factor.
- **P** = conservation practice factor or BMP implementation.

13.1.5. Sediment Load Development Methodology

For each watershed of interest, the “existing” long-term sediment loading is estimated via the USLE sediment analysis, using default parameters and estimated C and P values. The USLE is designed as a method to predict average annual soil loss caused by sheet and rill erosion. While it can estimate long - term annual soil loss and guide on proper cropping, management, and conservation practices, it cannot be applied to a specific year or a specific storm.

The resultant sediment load calculation for each watershed is therefore expressed as a long-term annual soil loss expressed in tons per year calculated for the R - the rainfall erosivity index, a statistic calculated from the annual summation of rainfall energy in every storm (correlates with raindrop size) times its maximum 30 - minute intensity.

The watershed sediment load target is based on the long - term annual soil loss expressed in tons per year calculated for relatively unimpacted watershed with demonstrated healthy biology and habitat. For the initial sediment load development consistent default parameters and inputs are used for each watershed. These include the MRLC land use data, the USGS DEM data, STASTGO soil information and watershed average C and P values for each land use type.